



# **What's Operations Research? and Why Should We (Interagents) Care?**

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9 February 2010

Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE <b>09 FEB 2010</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2010 to 00-00-2010</b>	
4. TITLE AND SUBTITLE <b>What's Operations Research? and Why Should We (Interagents) Care?</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>The MITRE Corporation, 202 Burlington Road, Bedford, MA, 01730-1420</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>Interagency Meeting This is an online meeting held 9-10 February 2010. U.S. Government or Federal Rights License</b>					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>12</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

# Overview

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- Operations Research (OR) defined
- History of OR / MORS support
- Potential interagency OR applications
- Summary

# OR Defined

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- Operations Research is:
  - Multi-disciplinary approach applying scientific method
    - Ask a Question
    - Do Background Research
    - Construct a Hypothesis
    - Test Your Hypothesis by Doing an Experiment
    - Analyze Your Data and Draw a Conclusion
    - Communicate Your Results
  - Inform decisions amongst alternatives
  - Maximize the utility of limited resources
- Operations Research is *not*:
  - A limited set of optimization tools/techniques
    - Multi-variate regression, linear regression,

It's all about decision support  
If you have a decision to make, OR can help!

# MORS Background

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- Early Military Operations Research Symposium
  - First held at Corona Naval Ordinance Lab, CA; August 1957
    - Subject: Air Defense; 83 scientist attended
  - Ninth symposium (1962) held at Ft Monroe, VA as first National symposium
  - 11<sup>th</sup> Symposium ONR assumed organization responsibilities, hired contractor
- MORS incorporated under laws of Virginia as professional society in 1966
  - Sponsored by Navy, Army, Air Force, Marine Corps, Joint Staff, OSD
  - Department of Homeland Security joined Sponsor ranks in 2008
- Services
  - Annual symposium with special sessions and 33 working groups
  - 4-5 Special Meetings per year
  - PHALANX bulletin, MOR Journal, Heritage publications
  - Mentoring and networking within the OR profession

# OR History

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- Brief history of OR (from DSB Report on ISR applications)
  - World War I
    - Thomas Edison led anti-submarine warfare tactics study/development
  - World War II
    - English: C2 of fighter aircraft and ground-based radar for homeland defense against Hitler's Luftwaffe
    - American: Submarine search against Germany U-boats
  - Cold War
    - SIOP study of blast, thermal, nuclear effects and mission-asset allocation
  - 1986 Goldwater-Nichols Act
    - Brought independent (vs. McNamara's PPBS) use of systems analysis to requirement process
  - Joint Direct Attack Munition (JDAM) requirements analysis
    - Glenn Kent led reqmt defn and acquisition trade space optimization following Desert Storm
      - Weather, launch and leave, reduced crew workforce and cost

# Current OR Applications – MORS Meeting Foci

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- 33 working/6 composite groups meet at MORS' annual symposium
  - Homeland and International Operations
  - C4ISR & Net-Centric Operations
  - Joint Warfare
  - Resources/Readiness/Training
  - Acquisition
  - Interdisciplinary Advances in OR
- Recent Special Meetings
  - Power and Energy
  - Maritime Domain Awareness and Counter Piracy
  - Risk-Informed Decision Making for HLS Resource Allocation
  - Strengthening the Next QDR Through Timely and Relevant Analysis
  - Understanding the Consequences of Catastrophic Events: Using Methods and Tools to Analyze and Manage Incidents

# Sample MORSS Papers – Interagency Interest

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- Selection of papers presented at 77<sup>th</sup> MORSS (June 2009)
  - Overcoming Gaps Created by a Loss of Satellite Coverage
  - Effects of Situational Awareness on the Outcome of a Pandemic Influenza
  - Social-Science Foundations of Analysis for Counter-Terrorism
  - Public Opinion + Cultural Model + Experts = Extraordinary Insight
  - Vancouver 2010: Defense Against the Asymmetric Air Threat
  - Intelligent Adversary Risk Analysis
  - Social Network Analysis for Homeland Defense and Civil Support
  - Applying Crime Mapping and Analysis Techniques to Forecast Insurgent Attacks in Iraq and Afghanistan
  - Analyzing the Effectiveness of Mine Rollers/Persistent Surveillance Towers to Counter the Improvised Explosive Device Threat in Al Anbar, Iraq
  - Analysis of the Civilian Population in Stability Operations



# Industry Applications

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- Agriculture
  - Planting, procurement, distribution
- Airlines
  - Revenue management and pricing, network planning, crew scheduling, maintenance planning, parts inventory and fuel management
- Health care
  - Design of medical informatics, emergency room scheduling, resource modeling
- Manufacturing
  - Optimize factory operations, warehouse optimization, supply chain optimization
- Transportation
  - Air traffic control, trucking, railroad logistics ; real-time dispatching and delivery truck routing; international freight scheduling and container pricing

# OR Success Stories

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[http://www.orchampions.org/prove/success\\_stories.php](http://www.orchampions.org/prove/success_stories.php)

- Select industry
  - Agriculture
  - Auto/vehicle
  - Food
  - Government
  - Health care
  - Manufacturing
  - Mining
  - Package & freight delivery
  - Pharmaceuticals
  - Sports
  - Telecommunication
- Select function
  - Capital budgeting
  - Decision support systems
  - Finance
  - Inventory
  - Medical research
  - Resource management
- Select benefit
  - Optimize resources
  - Increase revenue
  - Improve customer service
  - Rescue troubled product
  - Save lives

# OR Success Stories

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- Achieving and Systematizing Operational Efficiency at the 2004 Olympics
  - Optimize construction planning, execution and event management
  - Focus on competition venues, transporting athletes and spectators, coordinating volunteers, and managing municipal operations
  - Savings: \$55 million in resource management; \$15 million planning and design process efficiencies
- Air New Zealand Masters the Art of Crew Scheduling
  - Improve scheduling tours of duty and rosters
  - Saved NZ\$15,655,000 per year while providing crew rosters that better respect crew members' preferences
  - *(How many frequent flies wish their airline would use OR???)*

# OR Success Stories

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- Identifying/Neutralizing Deadly Side Effects of Anticancer Drug, ALIMTA
  - Eli Lilly developed “antifolate” class, showed effectiveness on lung cancer
  - Life-threatening side effects halted development
  - Used multiple logistic regression to study “markers” that predict toxic reaction
    - Determined folic acid and B12 deficiencies
  - Result: Allowed FDA approval, providing lung cancer treatment
- Delivering Rapid Restoration Capacity for the AT&T Network
  - Needed plan for restoration capacity and rapid response to network failures
  - OR team developed amount/location of restoration capacity, min cost
  - Extended tool to re-optimize restored network

# Summary

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- OR is application of the scientific method to inform decisions
- Early applications were military operations focused
  - Lanchester equations of combat
  - Anti-submarine warfare
  - Air defense resource allocation
- General resource allocation/optimization
  - Federal Express optimizes day-to-day ops and strategic resource planning
- Interagency applications
  - Pandemic planning
  - Terrorist behavior modeling
  - Information sharing